UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Mr. Larry Lawson, Director
Division of Water Program Coordination
Virginia Department of Environmental Quality
629 Main Street
Richmond, VA 23219

Dear Mr. Lawson:

The Environmental Protection Agency (EPA) Region III is pleased to approve the Total Maximum Daily Loads (TMDLs) for the aquatic life (benthic) and primary contact use impairments on Abrams and Opequon Creek. The TMDLs were submitted to EPA for review in December 2003. The TMDLs were established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address an impairment of water quality as identified in Virginia's 1998, Section 303(d) list.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) designed to attain and maintain the applicable water quality standards, (2) include a total allowable loading and as appropriate, wasteload allocations (WLAs) for point sources and load allocations for nonpoint sources, (3) consider the impacts of background pollutant contributions, (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated), (5) consider seasonal variations, (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality), (7) consider reasonable assurance that the TMDL can be met, and (8) be subject to public participation. The enclosure to this letter describes how the TMDLs for the aquatic life and primary contact use impairments satisfy each of these requirements.

Following the approval of these TMDLs, Virginia shall incorporate the TMDLs into the Water Quality Management Plan pursuant to 40 CFR § 130.7(d)(2). As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL WLA pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please don't hesitate to contact Mr. Peter Gold at (215) 814-5236.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure

Decision Rationale

Total Maximum Daily Loads for
the Aquatic Life Use Impairments on Abrams and Opequon Creek

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the TMDLs for the aquatic life use (benthic) impairments on Abrams and Opequon Creek. EPA's rationale is based on the determination that the TMDLs meet the following eight regulatory conditions pursuant to 40 CFR §130.

1) The TMDLs are designed to implement applicable water quality standards.
2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3) The TMDLs consider the impacts of background pollutant contributions.
4) The TMDLs consider critical environmental conditions.
5) The TMDLs consider seasonal environmental variations.
6) The TMDLs include a margin of safety.
7) There is reasonable assurance that the TMDLs can be met.
8) The TMDLs have been subject to public participation.

II. Background

The Abrams and Opequon Creek Watersheds are located in Clarke and Frederick County, Virginia. The Abrams Creek Watershed is 12,278-acres in size. The impaired segment of Abrams Creek begins at its headwaters and terminates at its confluence with Opequon Creek. The Opequon Creek Watershed is 43,806-acres in size and encompasses the Upper and Lower Opequon Creek Watersheds and the Abrams Creek Watershed. The Upper Opequon Creek is not impaired and can be demarcated as the portion of Opequon Creek upstream of the Abrams Creek confluence. Lower Opequon Creek is the portion of the Creek downstream of its confluence with Abrams Creek. A large portion of both watersheds (Abrams Creek and Lower Opequon Creek) would be characterized as containing urban lands. Urban lands make up 51% percent of the Abrams Creek Watershed, the remaining land is composed of agricultural (27%) and forested (22%) lands. Agricultural lands account for 64% of the Lower Opequon Creek Watershed, the remaining land is composed of forest (26%) and urban (9%) lands.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed 10.80 miles of Abrams Creek (VAV-B09R) on Virginia's 1998 Section 303(d) list as being unable to attain the general standard for the aquatic life use. The Lower Opequon Creek impaired segment length was listed as 8.82 miles on Virginia's 1998 Section 303(d) list. The failure to attain the general standard for the aquatic life use was determined through biological assessments of the benthic macroinvertebrate community. Both Creeks also failed to attain the primary contact use based on violations of the fecal coliform criteria. This decision rationale will address the TMDLs for the impairment of the aquatic life use. Separate TMDLs were developed for the fecal coliform impairments.

Virginia's 305(b)/303(d) guidance states that support of the aquatic life beneficial use is determined by the assessment of conventional pollutants (dissolved oxygen, pH, and temperature); toxic pollutants in the water column, fish tissue, and sediments; and biological evaluation of benthic community data.[1] Therefore, a biological assessment of the benthic community can be used to determine a stream's compliance with the state's general standard for the aquatic life use. Virginia uses EPA's Rapid Bioassessment Protocol (RBPII) to determine status of a stream's benthic macroinvertebrate community.[2] This approach evaluates the benthic macroinvertebrate community between a monitoring site and its reference station. Measurements of the benthic community, called metrics, are used to identify differences between monitored and reference stations.[3] Please note that the state is currently in the process of changing this methodology to a stream condition index (SCI) approach.

As part of the RBPII approach, reference stations are established on streams which are minimally impacted by humans and have a healthy benthic community. These reference stations represent the desired community for the monitored sites. Monitored sites are evaluated as non-impaired, slightly impaired, moderately impaired, or severely impaired based on a comparison of the biological communities of the reference and monitored sites. Streams that are classified as moderately (after a confirmatory assessment) or severely impaired after an RBPII evaluation are classified as impaired and are placed on the Section 303(d) list of impaired waters. During the 1998 assessment period, Abrams and Lower Opequon Creek were identified as being moderately impaired. They both continue to be assessed as moderately impaired on the RBPII and are impaired using the SCI.

The RBPII assesses the health of the macroinvertebrate community of a stream. The analysis will inform the biologist if the stream's benthic community is impaired. However, it will not inform the biologist as to what is causing the degradation of the benthic community. Additional analysis is required

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[1]VADEQ. 1997. 1998 Water Quality Assessment Guidance for 305(b) Water Quality Report and 303(d) TMDL Priority List Report. Richmond, VA.

[2]Tetra Tech 2002. Total Maximum Daily Load (TMDL) Development for Blacks Run and Cooks Creek. Fairfax, Virginia.

[3]Ibid 2

to determine the pollutants which are causing the impairment. TMDL development requires the identification of impairment causes and the establishment of numeric endpoints that will allow for the attainment of designated uses and water quality criteria.[4] A reference watershed approach was used to determine the endpoints for both the Abrams and Lower Opequon Creek TMDLs. Numeric endpoints represent the water quality goals that are to be achieved through the implementation of the TMDLs and will allow both creeks to attain their designated uses. A reference watershed approach is based on selecting a non-impaired watershed that shares similar landuse, ecoregion, and geomorphological characteristics with the impaired watershed. The stream conditions and loadings in the reference stream are assumed to be the conditions needed for the impaired stream to attain standards.

To determine whether a stream was a suitable reference site for the monitored sites, the modelers evaluated the topography, soils, ecoregion, landuses, watershed size, and point source inventory of the potential reference site. All reference site candidates had to be nonimpaired in the biomonitoring analysis. Based on the above discussion the reference site selected for both Abrams and Lower Opequon Creek was the Upper Opequon Creek. Since it is within the same watershed Upper Opequon Creek was very similar to the two impaired streams in landuse character and geology. Upper Opequon Creek was evaluated as unimpaired in the 2002 biological assessment period using the RBPII approach.

The next step in the TMDL development process was to determine the loadings and stressors in the monitored and reference watersheds. Low dissolved oxygen (DO), sedimentation, habitat modification, nutrients, and toxic pollutants were evaluated as possible stressors to the monitored streams. Ambient water quality monitoring on the streams documented temperature, DO, pH, turbidity, total suspended solids, nitrogen, and phosphorous levels. To get a better understanding of the daily DO concentrations, a diel DO analysis was conducted from August 12 through 13 of 2003. These samples were taken at the end of the summer season when the lowest DO concentrations are expected to be found due to a combination of high water temperatures (lower solubility of oxygen) and low flows. The results of the DO sampling failed to detect a violation of the standard. This data was used to remove nutrients and organic matter as possible stressors since an excessive loading of either of these pollutants would be illustrated in DO concentrations below the numeric criteria.

Toxics were evaluated through previous sediment and water samples collected within the watersheds in 1996, 1999, and 2001. The testing failed to reveal any contaminant above the possible effects concentration (PEC) in any of the water samples or the sediment samples taken in 1996 and 1999 from either stream. However, chlordane and mercury were found slightly above their PECs in sediment samples taken from Abrams and Lower Opequon Creek in 2001. It should be noted that in the previous sampling effort the detection limits were above the PECs for both contaminants. However, toxicity was not viewed as a stressor for either watershed because the majority of the samples failed to reveal any toxics and the exceedances were only slightly above the PEC.

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[4]Ibid 2

In general, the monitored waters had poorer water quality than the reference water, please see Section 4.0 of the TMDL document for additional information. Sediment was viewed as the stressor (pollutant) of concern that was causing or contributing to the benthic impairment on the impaired waters. Ambient water quality data did not document a reoccurring problem with suspended solids on either water. However, benthic monitoring and habitat assessments pointed to sediment as the stressor. The benthic assessment indicated poor scores for organisms requiring clean course substrate and site observations revealed that sediment was blanketing the stream channel and covering the desired course substrate. Sediment impacts the benthic community by filling in desired habitat spaces for organisms which seek this habitat for protection from flow, it clogs an organisms gill surface which may cause respiratory distress, and lowers visibility which may impact an organisms ability to find consumptive matter. The TMDLs were developed to control sediment, the controls for sediment will also reduce the levels of nutrients and organic matter reaching the Creeks.

The next step in developing these TMDLs was to determine the loadings of sediment (the stressor) to the monitored and reference segments. The Generalized Watershed Loading Functions (GWLF) model was selected as the means to determine loadings to the streams. The GWLF model provides the ability to simulate runoff, sediment, and nutrient loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land).[5] GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.[6] Monthly calculations are made for sediment based on daily water balance totals that are summed to give monthly values. To equate the reference watershed with the monitored watersheds, the reference watershed was decreased in size to that of that of Abrams Creek for the Abrams Creek TMDL and increased to the size of the Opequon Creek Watershed for the Lower Opequon Creek TMDL. In order to do this properly, the landuses were proportionally increased/decreased based on the percent land use distribution. Therefore, the landuse breakdown in the reference watershed remained constant.

Local rainfall and temperature data were needed to simulate the hydrology. The Winchester WINC weather station was used for temperature and precipitation data for the TMDLs. Stream flow data was available for both Abrams and Opequon Creek. A United States Geological Survey (USGS) gage was located in the mouths of Abrams and Upper Opequon Creek. The USGS gages for both watersheds were operated from the 1940s to 1997. This gave an ample data period for calibration of the model. The calibration was based on flows from April 1981 to December of 1987. The first nine months of the calibration were used to initialize the storage parameters within the GWLF model, the output of the model was then compared to the remaining six years of flow data. The model output was compared with observed data on a seasonal basis and runoff type (baseflow versus surface runoff). The models for both Abrams and Opequon Creek matched the observed data very well as is illustrated in Tables 6.8 and 6.9 of the TMDL Report.

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[5]Ibid 2

[6]Ibid 2

The TMDLs investigated future land uses by quantifying the expected loadings after completing 25 and 50% of the area's development plans. Table 1 documents the allocations to the Creeks.

Table 1 - Summarizes the Specific Elements of the TMDLs.

Segment	Parameter	TMDL (tons/yr)	WLA (tons/yr)	LA (tons/yr)	MOS (tons/yr)*
Abrams Creek	Sediment	6,327	470	5,224	632
Lower Opequon	Sediment	53,761	892	47,493	5,376

* Virginia includes an explicit MOS by reserving the 10 percent of total loading to the MOS.

The United States Fish and Wildlife Service has been provided with copy of this TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing an aquatic life use (benthic) impairment TMDLs for Abrams and Lower Opequon Creek. EPA is therefore approving these TMDLs. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDLs are designed to meet the applicable water quality standards.

The impaired waters were listed as impaired due to a degradation of the benthic macroinvertebrate community. As mentioned above, benthic assessments inform the biologist of an impairment, but they are unable to identify a stressor. Therefore, the TMDL developers were required to determine the stressor of concern. The TMDL developers evaluated ambient water quality data, sediment data, and biological and habitat assessments. After this evaluation, the TMDL developers determined that excessive sediment loadings to the impaired waters were impacting their benthic community. Unfortunately, the Commonwealth does not have numeric criteria for sediment at this time. Therefore, a reference watershed approach was used to obtain an appropriate numeric endpoint for these Creeks. Its believed that if the loading rate associated with the Upper Opequon Creek can be obtained in the impaired waters, the impairment to the benthic community will be relieved.

The GWLF model was used to determine the loading rates of sediment to the creeks from all point and nonpoint sources. The TMDL modelers determined the sediment loading rates within each watershed. Data used in the model was obtained on a wide array of items, including farm practices in the area, point sources in the watershed, land uses, weather, stream geometry, etc..

The GWLF model provides the ability to simulate runoff, sediment, and nutrient loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land).[7] GWLF is a

[7]Ibid 2

continuous simulation model that uses daily time steps for weather data and water balance calculations.[8] To equate the reference watershed with the monitored watersheds, the reference watershed was increased/decreased in size in the model based on the size of the impaired water. Each landuse was increased/decreased in equal proportion, insuring that the land use breakdown in the reference watershed remained constant. Weather and flow data were needed to simulate the hydrology of the impaired and reference waters, this data was obtained from gages (stream flow and weather) within the watersheds. In the GWLF model, the nonpoint source load calculation is affected by terrain conditions, such as the amount of agricultural land, land slope, soil erodibility, farming practices used in the area, and background concentrations of nutrients in soil and groundwater.[9] Parameters within the model account for these conditions and practices and were adjusted in order to simulate the observed flow data as accurately as possible.

EPA believes that using GWLF, to model and allocate the sediment loadings to the impaired waters, will ensure the attainment of the aquatic life use on these waters.

2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of sediment to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 1 of this document. The total allowable load is calculated on an annual basis.

Waste Load Allocations

Virginia has stated that there are sixty regulated point sources discharging to Abrams and Opequon Creek. Two of these facilities are municipal separate storm sewer systems (MS4s), these systems are dedicated to the collection and discharge of stormwater. The two MS4 systems are the City of Winchester and Virginia Department of Transportation. The stormwater loading between these two sources could not be segregated as it is difficult to ascertain in the models the specific roads and jurisdictions. The remaining dischargers are traditional NPDES permitted facilities. For the non-stormwater sources the WLA can be determined by multiplying the permitted flow by the permitted pollutant concentration. MS4 loads from Abrams Creek that were counted in the Lower Opequon were reduced by applying a ratio (0.55) to account for the different upstream drainage areas in the two

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[8]Ibid 2

[9]Ibid 2

watersheds used in calculating watershed sediment delivery ratios.[10]

EPA regulations require that an approvable TMDL include individual waste load allocations (WLAs) for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Table 2a - TSS WLAs for Abrams and Opequon Creek

Facility Name	Permit Number	Creek	Existing Load (t/yr)	Allocated Load (t/yr)
Perry S.M.	VA0002739	Abrams	4.15	4.15
I-81 Rest Area STP	VA0023116	Opequon	0.50	0.50
A&K Car Wash	VA0027600	Opequon	0.41	0.41
Shalom et Benedictus Lagoon	VA0029653	Opequon	0.29	0.29
National Fruit	VA0051373	Abrams	2.49	2.49
Opequon Regional AWT	VA0065552	Opequon	506.05	506.05
Perkins Mill STP	VA0075191	Opequon	82.91	82.91
Abex	VA0076384	Abrams	20.73	20.73
Frederick County Landfill	VA0088471	Opequon	3.32	3.32
Stonebrook Swim Club	VA0088722	Opequon	0.16	0.16
Franciscan Center	VA0089010	Opequon	0.07	0.07
APAC Virginia WWTP	VA0090808	Opequon	0.22	0.22
45 Single Family Treatment Units	General Permits	Opequon	1.865	1.865
MS4- City of Winchester	VAR040053	Abrams/ Opequon	527.0	442.7
MS4- VDOT	VAR040032	Abrams/ Opequon		

Load Allocations

[10]Virginia Tech 2003. Opequon Watershed TMDLs for Benthic Impairments: Abrams Creek and Lower Opequon Creek, Frederick and Clarke Counties, Virginia. Blacksburg, Virginia.

According to Federal regulations at 40 CFR 130.2(g), load allocations (LAs) are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the GWLF model to represent the impaired watershed. The GWLF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality. GWLF uses precipitation data for continuous and storm event simulation to determine total loading to the impaired segments from the various land uses within the watershed. Stream channel erosion was identified as the largest source of sediment to the impaired waters and required the largest reductions. Tables 3a and 3b list the LAs for the impaired waters.

Table 3 - LA for Sediment for Abrams Creek

Source Category	Existing Load (t/yr)	Proposed Load (t/yr)	Percent Reduction
Agriculture	1,363	1,142	17
Urban	1,330	1,061	21
Forestry	36.1	36	0
Channel Erosion	5,648	2,992	47

Table 3b - LA for Sediment for Lower Opequon Creek

Source Category	Existing Load (t/yr)	Proposed Load (t/yr)	Percent Reduction
Agriculture	13,575	11,187	17
Urban	3,582	3,412	5
Forestry	93.4	93.4	0
Channel Erosion	40,029	32,806	18

3) The TMDLs consider the impacts of background pollution.

The reference watershed approach inherently considers the impact of background pollutants by considering the sediment load from all land uses within the impaired and reference watersheds.

4) The TMDLs consider critical environmental conditions.

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the impaired creeks is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[11]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The GWLF model was run over a multi-year period to insure that it accounted for a wide range of climatic conditions. The allocations developed in the TMDL will therefore insure that the criteria is attained over a wide range of environmental conditions.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Pollutant loadings also change during the year as vegetation grows and less sediment is available for runoff. Consistent with our discussion regarding critical conditions, the GWLF model and TMDL analysis effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time and modifying the soil loss equations based on the time of the year.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia includes an explicit MOS by allocating 10 percent of the total TMDL loading to the MOS.

7) There is a reasonable assurance that the TMDLs can be met.

EPA requires that there be a reasonable assurance that the TMDLs can be implemented.

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[11]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

The TMDLs in their current form are designed to meet the applicable water quality standards. The Commonwealth intends to implement these TMDLs through best management practices (BMPs). The implementation of these practices will occur in stages. This will allow the Commonwealth to monitor the benefits of the BMPs and determine which practices have the greatest impacts on water quality. It will also provide a mechanism for developing public support and checking the accuracy of the model.

8) The TMDLs have been subject to public participation.

The first public meeting for Abrams Creek was held on March 13, 2003 at Shenandoah University in Winchester, Virginia. The first public meeting for Lower Opequon Creek was held on April 3, 2003 at the same location. Both meeting were attended by 45 people and had a thirty-day comment. A final public meeting to address both benthic TMDLs was held at Shenandoah University on July 1, 2003. Approximately 10 people attended the meeting and the comment period closed August 01, 2003.